



**CHENMKO ENTERPRISE CO.,LTD**

**2N7002ESPT**

**SURFACE MOUNT**

**N-Channel Enhancement Mode Field Effect Transistor**

VOLTAGE 60 Volts CURRENT 0.300 Ampere

*Lead free devices*

**APPLICATION**

- \* Relay driver
- \* High speed line driver
- \* Logic level transistor

**FEATURE**

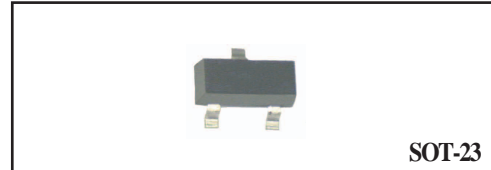
- \* Small surface mounting type. (SOT-23)
- \* High density cell design for low  $R_{DS(ON)}$ .
- \* Suitable for high packing density.
- \* Rugged and reliable.
- \* High saturation current capability.
- \* ESD protect in input gate 1.5KV

**CONSTRUCTION**

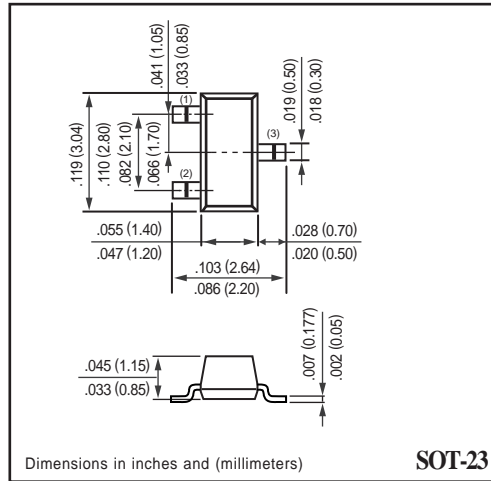
- \* N-Channel Enhancement with ESD protection in input

**MARKING**

- \* PK1

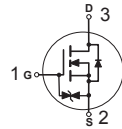


**SOT-23**



**SOT-23**

**CIRCUIT**



**Absolute Maximum Ratings**  $T_A = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	2N7002ESPT	Units	
$V_{DSS}$	Drain-Source Voltage	60	V	
$V_{DGR}$	Drain-Gate Voltage ( $R_{GS} \leq 1\text{ M}\Omega$ )	60	V	
$V_{GSS}$	Gate-Source Voltage - Continuous	$\pm 20$	V	
	- Non Repetitive ( $t_p < 50\mu\text{s}$ )	$\pm 40$		
$I_D$	Maximum Drain Current - Continuous - Pulsed	$T_A = 25^\circ\text{C}$	300	mA
		$T_A = 100^\circ\text{C}$	190	
$P_D$	Maximum Power Dissipation	$T_A = 25^\circ\text{C}$	830	mW
		$T_A = 100^\circ\text{C}$	500	mW
$T_J, T_{STG}$	Operating and Storage Temperature Range	-65 to 150	$^\circ\text{C}$	
$T_L$	Maximum Lead Temperature for Soldering Purposes, 1/16" from Case for 10 Seconds	300	$^\circ\text{C}$	

**Thermal characteristics**

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	350	$^\circ\text{C/W}$
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## RATING CHARACTERISTIC CURVES ( 2N7002ESPT )

**Electrical Characteristics**  $T_A = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
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### OFF CHARACTERISTICS

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 10\ \mu\text{A}$	60	75		V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}$			1.0	$\mu\text{A}$
		$T_J = 150^\circ\text{C}$			10	$\mu\text{A}$
$I_{GSSF}$	Gate - Body Leakage, Forward	$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$			500	nA
$I_{GSSR}$	Gate - Body Leakage, Reverse	$V_{GS} = -15\text{ V}, V_{DS} = 0\text{ V}$			-500	nA

### ON CHARACTERISTICS (Note 1)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1.0\text{ mA}$	1	2.0	2.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 500\text{ mA}$		2.8	5.0	$\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 75\text{ mA}$		3.8	5.3	
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}, V_{GS(on)}, I_D = 200\text{ mA}$	100	300		mS

### DYNAMIC CHARACTERISTICS

$C_{iss}$	Input Capacitance	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		13	40	pF
$C_{oss}$	Output Capacitance			8	30	
$C_{rss}$	Reverse Transfer Capacitance			4	10	
$t_{on}$	Turn-On Time	$V_{DD} = 50\text{ V}, R_L = 250\ \Omega,$ $V_{GS} = 10\text{ V}, R_{GEN} = 50\ \Omega$		3	10	nS
$t_{off}$	Turn-Off Time	$V_{DD} = 50\text{ V}, R_L = 250\ \Omega,$ $V_{GS} = 10\text{ V}, R_{GEN} = 50\ \Omega$		9	15	nS

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

$I_S$	Maximum Continuous Drain-Source Diode Forward Current			300	mA	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current			1.2	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 200\text{ mA}$ (Note 1)		0.85	1.5	V
$t_{rr}$	Reverse Recovery Time	$I_S = 300\text{ mA}, di_S/dt = -100\text{ A/uS}$		30		nS
$Q_r$	Recovery Charge	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}$		30		nC

Note:

1. Pulse Test: Pulse Width < 300 $\mu\text{s}$ , Duty Cycle < 2.0%.

# RATING CHARACTERISTIC CURVES ( 2N7002ESPT )

## Typical Electrical Characteristics

Figure 1. On-Region Characteristics

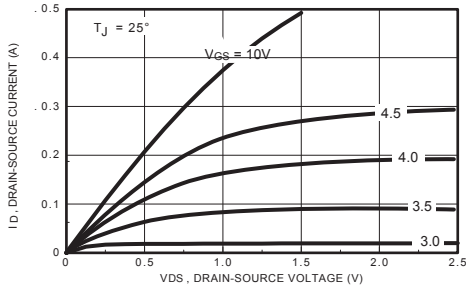


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

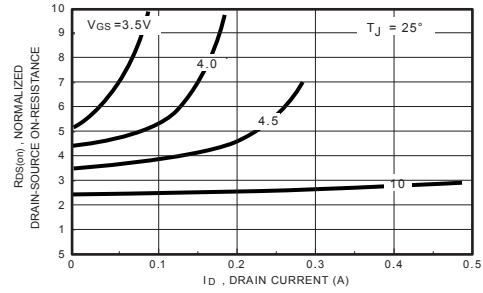


Figure 3. On-Resistance Variation with Temperature

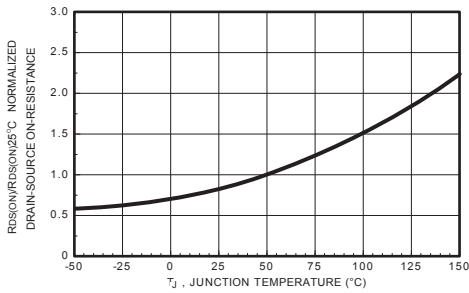


Figure 4. Sub-Threshold Drain Current with Gate - Source Voltage

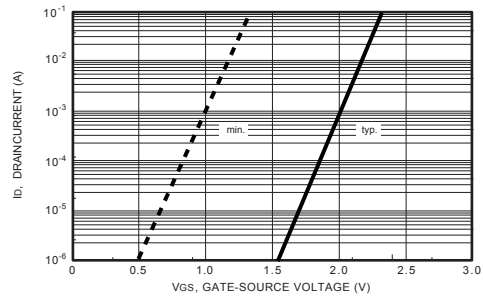


Figure 5. Transfer Characteristics

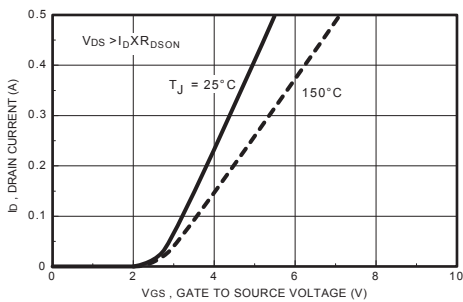
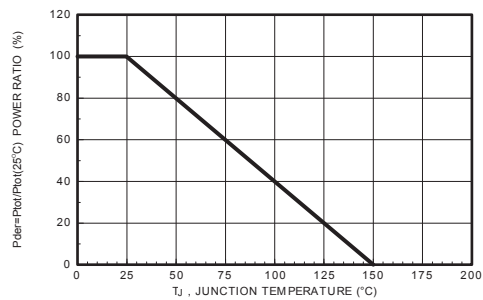


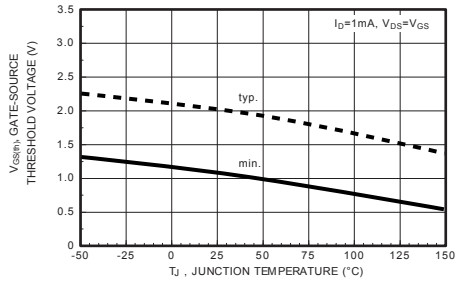
Figure 6. Power Derating Curve



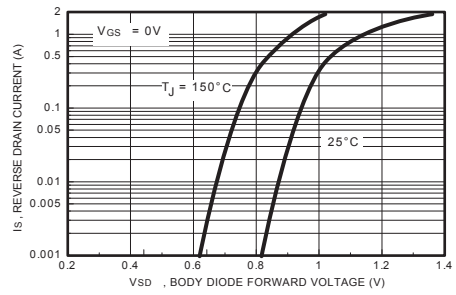
# RATING CHARACTERISTIC CURVES ( 2N7002ESPT )

## Typical Electrical Characteristics (continued)

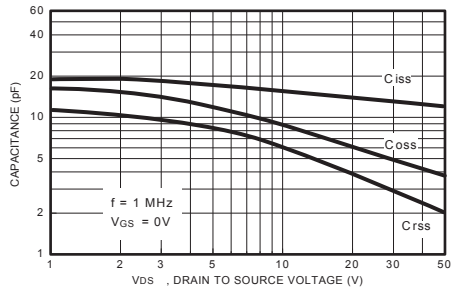
**Figure 7. Gate-Source Threshold Voltage with Temperature**



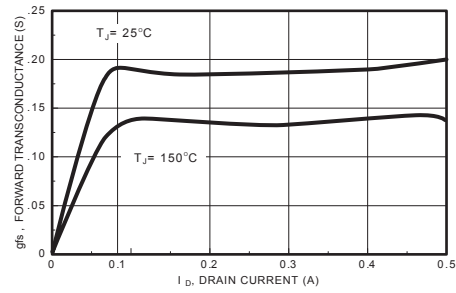
**Figure 8. Body Diode Forward Voltage Variation with Drain Current**



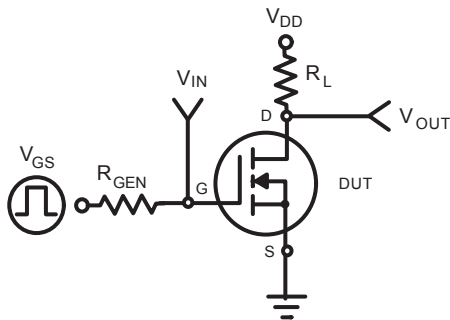
**Figure 9. Capacitance Characteristics**



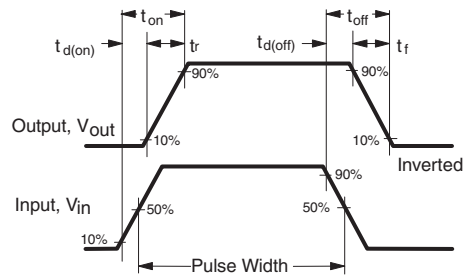
**Figure 10. Forward Transconductance**



**Figure 11.**



**Figure 12. Switching Waveforms**



## RATING CHARACTERISTIC CURVES ( 2N7002ESPT )

### Typical Electrical Characteristics (continued)

Figure 13. Maximum Safe Operating Area

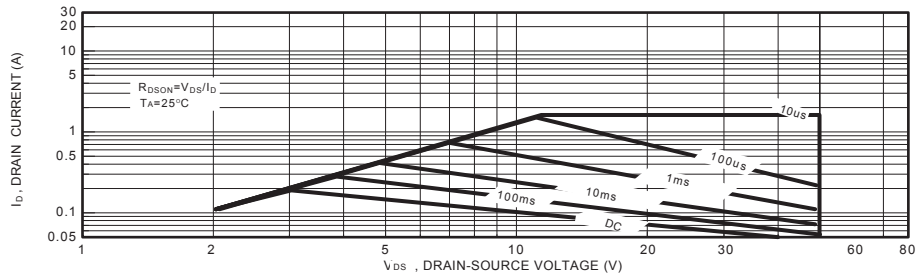


Figure 14. Transient Thermal Response Curve

